

Dental care during and after radiotherapy in head and neck cancer

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ABSTRACT

Head and neck cancer is a major health problem. Oral cancer is increasing in Indian subcontinent mainly due to lack of hygiene, tobacco use, chewing tobacco, smoking, and many other factors. Radiation therapy is the most common form of treatment along with surgery and chemotherapy. There are 2 types of complication that occurs during and after radiotherapy, that occur because of effects on normal tissue. Radiotherapy-induced effects occur on the oral mucosa salivary glands, bone, teeth, and musculature of face and neck. These complications needs special attention for their prevention and treatment, Preradiotherapy evaluation and disease stabilization are necessary in every patient, counseling of patients before during and after radiotherapy is important to help them become aware of several oral complications and their prevention.

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INTRODUCTION

Head and neck cancer is a major health problem worldwide.^[1] It is a major global health unit, with about half a million new cases diagnosed per year, and their incidence appears to be increasing in developing countries.^[2]

Cancer is the second most common cause of morbidity and mortality. Six million people die due to cancer every year. It is estimated that by 2020, there will be 15 million new cases every year. The incidence of oral cancer is of increase in several parts of the world particularly in Australia, Japan, and Parts of Europe, Oropharyngeal cancer is a significant part of global burden of cancer, oral cancer occurrence is particularly high in males in comparison to females.^[3,4]

Head and neck cancer accounts for one of the fourth of all cancers in Indian males. In South Asia, oral cancer accounts for about up to 40% of all cancers. In India, the incidence of oral cancer is about 3–7 times more common as compared to resource-rich countries. Oral cancer is the third most common cancer in India after cervical and breast cancer among women. In India, age-standardized incidence rate of oral cancer is reported at 12.6 per 100,000 population highest age-adjusted incidence for oral cancer in highest in India, that is 15.7/100,000 and lowest in Japan which is 2/100,000 and difference is predominantly due to use of tobacco between two countries. The increased prevalence of the oral cancer in the Indian subcontinent seems to be due to the, smoking, alcohol, use of smokeless tobacco, spicy food and lack of fruit and fiber intake, and neglected oral health and hygiene. In the West, the cancer of tongue and floor of mouth is common where in Indian subcontinent the cancers of gingivobuccal sulcus, tongue, buccal mucosa are common due to placement of tobacco quid under the tongue, under the buccal mucosa and under the lip (oral cancer prevention and research foundation India).^[4]

Human papilloma virus especially types 16 and 18 are known risk factors (there are over 100 variables) and independent causative factor for oral cancer.^[4] Tobacco and alcohol are strong synergistic effects or oral cancer.

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There are strong synergistic effects on oral cancer risk when a person is both (smoker and drinker) tobacco use including smokeless tobacco excessive intake of alcohol intake estimated to account for about 90% of oral cancers.^[3]

The oral complication of head and neck radiation can be divided into two groups based on the actual time of their occurrence. Acute complication occurs during radiation therapy (RT), and late complication occurs after RT has completed. The anatomy and physiology of this region are unique and complex. Function and appearance are critical to patients images quality-of-life, most patients with head and neck squamous cell carcinoma are middle-aged, adult males in lower socioeconomic classes who are chronic tobacco chewer and alcohol consumers have advanced tumors. These patients tend to be less conscious and to have less social support than most cancer patients.

It is important to prevent and treat orofacial complication which require a multi-disciplinary approach that include a dedicated team of radiation oncologist, head and neck surgeon, dentist, nurse, dietician, physical therapist, social worker and in some instances, plastic surgeon, prosthodontist, and psychologist are required.

RADIATION DOSIMETRY

Radiotherapy is concerned with the delivery of the correct radiation dose to the tumor while minimizing the dose received outside the tumor zone. Radiation doses are expressed in the standard unit the gray (Gy) which is defined as J/kg.^[5] Rothwell states that most orofacial complications are dose dependent and that severe side effect occurs when doses <45 Gy administered to the bilaterally to the mouth, jaws, and salivary gland.^[5]

COMPLICATIONS OF HEAD AND NECK RADIATION

Oral complications of head and neck radiation are more predictable are often more severe and can lead to permanent tissue changes that the patient at risk for serious chronic complication, patients should go for:

- Preradiation dental evaluation and oral disease stabilization
- Oral complication of head and neck radiation
- Management of
 - Oral mucositis
 - Early infections
 - Taste dysfunction
 - Xerostomia.

PRERADIATION DENTAL EVALUATION AND ORAL DISEASE STABILIZATION

Elimination of oral disease and implementation of oral protocols designed to maintain maximum oral health must be components of patients' assessment and care before RT begins patients should receive a comprehensive oral evaluation several weeks before radiation begins. This time provides an appropriate interval for tissue healing in the event that invasive oral procedures, including tooth extraction, dental scaling/polishing, and endodontic therapy are necessary.

- The goal of this evaluation is to identify teeth at significant risk of infection broken teeth that would optimally require aggressive or invasive dental treatment during and after the radiation that increases the risk of soft tissue necrosis and osteonecrosis
- Take necessary radiographs such as a panoramic and a full mouth. Perform a full mouth examination including periodontal charting. These steps will identify potential source of infection and needed dental work, such as caries, broken restorations sharp edges and overhangs, orthodontia bands removed, and partial and full dentures cleaned and adjusted. Preradiation extractions should be done 10–21 days earlier to avoid the risk of osteoradionecrosis (ORN). All major surgeries should be performed 4–6 weeks in advanced to start of radiotherapy
- Perform a complete prophylaxis with a fluoride treatment and home care instruction for plaque control^[5]
- Before protocalling the patients, the practitioner should requisit the diagnosis, prognosis treatment plan, and medical history from the oncologist.

RADIATION INDUCED COMPLICATIONS

The oral complications of head and neck radiation can be divided into two groups on the basis of the usual time of their occurrence.

*Acute complications – A therapeutic dose of radiation in head and neck cancer usually comprises a total of 64 Gy to 70 Gy in 32–35 fractions with the daily dose of 1.8–2.0 Gy/fraction. Acute complication appears 1–2 weeks after radiation starts, it depends on dose and site of radiation also.^[6]

- Oropharyngeal mucositis^[7]
- Change in salivary composition
- Alteration of taste (Dysguesia)
- Infection (bacterial, fungal and viral)
- Periodontium pain
- Chronic complication:
 - Trismus and fibrosis
 - Malnutrition

- Osteo radionecrosis
- Dental caries
- Xerostomia.

These symptoms can subside 2–4 weeks after completion of radiotherapy occasionally tissue necrosis can be seen late during therapy, but this is relatively rare.^[6]

RADIATION MUCOSITIS

One of the earliest complications of RT is the development of mucositis. The soft tissues in the treatment field after a week or two demonstrate a moderate amount of erythema. As the radiation continues, the mucosa may exhibit varying degree of desquamation and frank ulceration, resulting in pain and dysphagia which makes patients to eat a well-balanced diet leading to significant weight loss and malnutrition.^[8] Mucositis is common life-threatening acute adverse effect due to early changes in the oral mucosal tissue which is extremely sensitive to radiation dose.^[9] The development of mucositis depends on the dose of radiation, angulations to the beam location of tumor and the degree of oral hygiene, mucositis can occur anywhere there is oral mucosa including the oral cavity, esophagus, larynx, and pharynx, clinically, the oral mucositis appear to be due to epithelial thinning and vasodilatation. This can lead to ulceration or mouth sores, sloughing of the epithelium, and crusting of lips. Oral mucositis causes serve pain and increases the risk for the development of systemic infection from bacterial, fungal, or viral infection in the mouth.^[10]

WHO GRADING OF MUCOSITIS

Common sites of oral cavity mucositis including the buccal, labial, and soft palate mucosa along with ventral surface of tongue, floor of the mouth. If the pharynx is involved, the individual may have a sore throat and difficulties in swallowing and talking. Esophagitis is caused by damage to the mucosal lining and usually presents as dysphagia, mucosites can cause severe pain and increase the risk of development of systemic infections from bacterial, fungal, or viral infections in the mouth.

The hyperemic and edematous mucosa initially appears reddened. This erythema is due to a thinning of the epithelium and vascular dilation, inflammation and

edema of the submucosa.^[11] With continued radiotherapy, the mucosa becomes denuded, ulcerated and covered with fibrinous exudates. This is accompanied by pain, burning, and discomfort, which are greatly aggravated by contact with coarse or highly seasoned food.

Depending on the extent of the treatment field involvement of the pharyngeal mucosa, may produce difficulties in swallowing and speech this is often at its worst in 2–3 weeks treatment. With symptoms usually diminishing there after completion of treatment.^[12] After 4 weeks of treatment, 90–95% of patients show complete resolution of mucositis and sore throat is absent or minimum.^[9]

NATIONAL CANCER INSTITUTE COMMON TERMINOLOGY CRITERIA FOR ADVERSE EVENTS VERSION 4

- Grade 1 – Asymptomatic or mild symptoms; intervention not indicated
- Grade 2 – Moderate pain; not interfering with oral intake
- Grade 3 – Severe pain; interfering with oral intake
- Grade 4 – Life-threatening consequences; urgent intervention indicated
- Grade 5 – Death.

ADVISE

- Radiation patients should be monitored weekly as needed to ensure they are not developing mouth sores
- Patients should be advised to eat a small amount of meals 4–6 portion daily rather than three big meals
- Intake of easy to swallow nutritious fluid and such as soups, milk shakes, and curd should be increased
- Psychological counseling if required.^[11]

Maintain oral hygiene

- Brush teeth and gum with a soft bristle brush 2–3 times a day for 2–3 min
- Rinse the toothbrush in hot water every 10–30 s to soften the bristle if needed
- Use antibacterial rinse
- Use a fluoride toothpaste with a mild taste, flavoring may irritate the mouth, (especially mint flavoring)
- Rinsing. Use every 2 h to decrease soreness in the mouth, dissolve ¼ teaspoon of salt and ¼ teaspoon of baking soda in 1 glass of water
- Use lip care products such as cream with lanolin to prevent drying and cracking.

DENTURE CARE

Brush and rinse everyday use a soft bristle toothbrush as one made for cleaning of the denture. Keep dentures

Grade 0	No oral mucositis
Grade 1	Erythema and soreness
Grade 2	Ulcers, able to eat solids
Grade 3	Ulcers require liquid diet (due to mucositis)
Grade 4	Ulcers, alimentation not possible (due to mucositis)

moist when not being worn, place them in water or a denture soaking solution.

Mucositis severity increases and topical pain management strategies become less effective it becomes necessary to depend on systemic analgesic to manage oral radiation mucositis pain.

Because there is generally no risk of bleeding for head and neck radiation patients' analgesic, treatment begins with nonsteroidal anti-inflammatory drugs (NSAIDs)

As pain increase, NSAIDs are combined with and patients can be made relatively comfortable.

Prevention may be the most important factor for the development of oral mucositis, however, it is difficult to prevent as well as treat.

Acute mucositis begins during the second or 3rd week of RT and subsides within 8–10 weeks after treatment is completed. Good oral hygiene is perhaps the best way to reduce the complications. Frequent daily cleaning of the teeth and oral rinse with a combination of salt and sodium bicarbonate in water or dilute solution of hydrogen peroxide and water having a soothing effect on the affected areas. Other therapies have included rinsing with Benadryl elixirs, sucrate fate solutions, and topical anesthetics.^[9]

INFECTIONS

Damage to the lining of the mouth and weakened immune system makes it easy for the infection to occur. Oral mucositis breaks down the lining of the mouth which lets, bacteria, viruses, and fungal get into the blood.

Dry mouth which is common during radiotherapy to head and neck may also raise the risk of infection in the mouth.

Infection may be caused by bacteria, virus or fungal.

A systemic review indicated that the weighted mean prevalence of clinical oral candidiasis during head and neck RT is 37.4%. Factors promoting clinical fungal infection in this population include the following:

- Hypo salivation resulting from radiation damage to the salivary gland
- Tissue damage caused by radiation-induced oral mucosites
- Resulting dietary impairment
- Inability to maintain oral hygiene.

In this case, topical antifungal agents such as nystatin rinse/pastilles and clotrimazole troches can be effective

patients who receive topical antifungal should be asked to avoid eating, drinking and rinsing for at least 30 min after use. For persistent lesions, systemic agents like fluconazole are very effective bacterial infection can be treated by

- Maintaining oral hygiene
- Oral antibiotics/systemic antibiotic
- Maintain nutritional status of the patients.

VIRAL INFECTION

Viral infections are not common in patients under radiotherapy treatment, continuing regular oral care will help to prevent infections.

LOSS OF TASTE

Loss of taste most common side effect during radiation to the tongue and palate during 1–2 weeks after radiotherapy which gradually returns back to normal after the course is completed. The most common contributing factors are damaged taste buds disrupted innervations and decreased salivary flow.^[13]

An oral and pharyngeal mucosa are exposed to radiation taste receptors become damaged and taste discrimination becomes increasingly compromised^[8,14] foods may seem to have no taste or may not taste the way they did before cancer treatment radiation may cause a change in sweet, sour, bitter, and salty taste for many patients, the taste buds may recover 6–8 weeks or more after RT ends. Zinc sulfate supplements may help some patients to recover their sense of taste (200 mg 2–3 times a day). This change can be permanent in some patients.^[9,15]

XEROSTEMIA

Saliva is made by salivary stands saliva is needed for taste swallowing and speech, it helps to prevent infection and tooth decay, by cleaning of teeth and gums and preventing too much acid is the mouth. Changes in the quantity and quality of saliva as a result of radiation have been well-documented in the dental literature [Table 1].

Table 1: Functions of saliva

Saliva has various functions
Cleaning effect of washing away food debris
Makes swallowing food easier
Antibacterial effect of fighting off bacteria entering the mouth
Lubricating effect that protects mucous membranes
pH buffering effect that prevents caries
Effect of promoting remineralization of teeth
Effect of protecting the tongue as a lubricant and developing the sense of taste

SYMPTOMS OF DRY MOUTH

- Thick, stringy saliva
- Increased thirst
- Changes in taste, swallowing or speech
- A sore or burning feeling
- Cuts or cracks in the lips or at the corner of the mouth
- Changes in the surface of the tongue.
- Problem wearing denture should be avoided.

Up to 64% of patients treated with conventional radiotherapy still experience a moderate to severe degree of a permanent xerostomia when assessed to up to 22 years after RT.^[16] Measures taken to reduce the severity of xerostomia are-

- Radiation stents can be fabricated to shield the ipsilateral side when unilateral radiation treatment is required
- Radiation techniques should be improved (use intensity-modulated irradiation technique)
- Patient should be encouraged to maintain adequate fluid intake and remain hydrated to prevent bacterial infections of the oral cavity
- Tongue should be cleaned 2 or 3 times daily with soda bicarbonate solution
- Sticky foods such as chocolate and pastries should be avoided
- Caffeine containing beverages, alcohol or strong flavors should be avoided
- Sugar-free candies, gums, and mint should be avoided
- Secretagogues that is, pilocarpine, anethole trithione, and cevimeline act by stimulating the functioning of salivary gland tissue
- Sugarless antifungal agents such as nystatin powder and clotrimazole can be used to treat infections.

DENTAL CARIES

Dental caries risk increases secondary to a number of factors including shift to a cariogenic flora, reduced concentration of salivary antimicrobial proteins and loss of mineralizing components.^[9] One of the most effective methods of treating this condition is through the daily use of topical application of fluoride. Both stannous and sodium fluoride have been used in a variety of forms with significant success.^[17]

After standard radiotherapy, there is a profound shift in the oral microflora to predominance of acidogenic microbes, primarily *Streptococcus mutans* and *Lactobacilli* coincident with a decrease in salivary flora and an increase in caries risk. Dental caries in irradiated patients may develop rapidly as early as 3 months after radiotherapy.

PREVENTION

- Strict daily oral hygiene that includes fluoride and meticulous plaque removal has been shown to prevent the development of caries^[17,18]
- Chlorhexidine gel has also been shown to clinically reduce caries risk^[9,17]
- Alcohol-free formulation should be selected to reduce discomfort in patients with dry mouth.^[17,19]

TRISMUS AND FIBROSIS

Trismus may begin shortly after radiation begins. Patients suffering from tumors of the palate, nasopharynx, and maxillary sinus are most likely to develop the trismus. If unmanaged, trismus makes eating and swallowing difficult and various dental clinical procedures almost impossible. Trismus can be significant side effect of radiotherapy especially if the lateral pterygoid muscles are in the field. In patients whom the pterygoid muscles were irradiated and not the temporomandibular joint 31% experienced trismus. In addition, radiation to the temporomandibular joint also was associated with a decrease in maximum vertical opening of the mouth. Limited mouth opening can interfere with proper oral hygiene and dental treatment. Tongue blades can be used to gradually increase the mandibular opening.^[20,21] Dynamic bite opening appliances have also been used. Primary treatment is essentially to exercise the involved muscles.^[22,23]

For patients who experience reduced mouth opening the intensity and frequency of the exercise should increase (physical therapy prescribed).

CHRONIC COMPLICATIONS

The long-term effects are due to changes in the vascularity and cellularity of soft tissue and bone, damage to salivary glands and increased collagen synthesis, leading to hypovascularity, hypocellularity, and hypoxia of the tissues: Common chronic complications are xerostomia, dental alteration, rampant caries, demineralization, alteration or loss of taste (dysgeusia), secondary opportunistic infection (e.g., candidiasis). Oral ulceration (soft tissue necrosis). Osteoradionecrosis, pain, temporomandibular joint disease, trismus, nutritional deficiencies, psychological impact. To a significant degree, the oral problem associated with RT can be prevented or minimized through optimal management.^[7]

XEROSTOMIA

Ionizing radiation causes normal salivary gland tissue damage, resulting in rapid loss of salivary fluid

function.^[24,25] The salivary glands are especially sensitive to radiation and show acute and chronic responses to radiotherapy.^[26] Of all of the salivary glands, the parotid gland is mainly affected because the serous cells are most sensitive.^[27] With a loss of saliva secretion, oral dryness, or xerostomia, is the chief symptom. The patient can become uncomfortable because there is no salivary lubrication, and the mucosal tissues become sticky. Individuals often complain of difficulty in swallowing (dysphagia), food sticking to the teeth, and a burning sensation when eating spicy food and fruit. As a result, there may be changes in eating patterns with a decrease in nutritional intake and weight loss. Dry mucosa may also be more prone to bleeding, resulting in bleeding gums.

An alcohol-free mouth rinse is recommended because the alcohol can be irritating and dehydrating to the oral mucosa. Sialogogic, cholinergic agents are used to stimulate saliva production from whatever salivary gland tissue remains. Pilocarpine, a muscarinic-cholinergic agonist, is a naturally occurring plant alkaloid that stimulates salivation. Cevimeline induces salivary function with minimal cardiac and pulmonary effects because it has a high affinity for the M3 muscarinic receptors on salivary glands. Bethanechol (Urecholine) is another cholinergic drug. Amifostine (Ethyol), an organic thiophosphate chemoprotectant agent, is Food and Drug Administration approved to reduce the incidence of moderate-to-severe xerostomia in patients undergoing postoperative radiation treatment for head and neck cancer. It is recommended for late xerostomia occurring at least 1-year after radiation. At this time, there is the most likely permanent fibrosis of the salivary glands.

Histatins, a family of salivary proteins, have potent antifungal properties which limit the growth of oral yeast. Salivary gland also secretes immunoglobulins A and M which specifically acts against oral cariogenic bacteria

TRISMUS AND FIBROSIS

Trismus and fibrosis will continue following RT, which will increase in severity with time. This condition will only improve with constant exercise regimen.^[28]

Exercise should be performed deliberately at regular intervals followed by a period of rest.^[14] More frequently and diligently the exercise regimen, the more beneficial the result. Chronic trismus gradually converts into fibrosis of the muscles and at this late stage stretching of muscle is not favored as a solution. Exercise must begin early in treatment regimen.

MALNUTRITIONS

Patients treated for head and neck cancer have a high risk of malnutrition patients may lose one desire to eat because of soreness of the mouth, trouble swallowing or dry mouth. When eating causes discomfort or pain, the patients quality of life and nutritional of wellbeing suffer.

- Nutritional support may include liquid diet and tube feeding
- High calorie, high protein liquid to meet their needs
- Intravenous infusion of nutritional supplements. Swallowing problems are managed by a team of experts
- Speech therapist
- Dietician
- Dental specialist
- Psychologist.

OSTEORADIONECROSIS

Osteoradionecrosis is a condition of a nonvital bone in the site of radiation injury. ORN can be spontaneous but it most related to hypovascular, hypocellular, and hypoxic conditions that exist in bone Marx has proposed that the result from radiation following radiation. Induced deficient cellular turnover and collagen synthesis in a hypoxic, hypovascular, and hypocellular environment in which tissue breakdown exceeds the repair capabilities of the wounded tissue.^[29] Clinically, ORN may initially present as bone lysis under gingiva and mucosa. This process is self-limiting because the damaged bone sequesters then is shed with subsequent healing. If the soft tissue breakdown, the bone becomes exposed to saliva and secondary contamination occurs. Sepsis may also be introduced by dental extraction or surgery producing a more aggressive form. This progressive^[30,31] from may produce severe pain or fracture and require extensive resection.

The reported incidence of ORN ranges from 0.92% of all head and neck cancer patients receiving radiotherapy.

Sulaiman *et al.* reviews the records of 1194 patients during 1998–2001. Meantime for follow-up was 22.9 months. They reported that selected tooth extraction before radiation therapy reduced the risk of necrosis when teeth had periodontal disease, particularly mandibular molars and furcation involvement. In the Becimer study, 2.14 percent developed ORN.

A recent retrospective study showed a further reduced incidence of ORN following intensity-modulated RT (IMRT) for head and neck cancer. This reduced incidence was attributed to parotid sparing and

better dental treatment which reduced the number of dental extraction and surgical procedures required postradiotherapy.^[32]

PREVENTION

Osteoradionecrosis may be prevented by extracting these teeth at least 2 weeks before radiotherapy, (periodontally involved teeth, unerupted teeth). Prevention of dental caries and periodontal disease and their sequelae can prevent ORN in most cases. If teeth are extracted after radiotherapy care should be given to use atraumatic technique, smooth sharp edges of bone, and avoid reflection of the periosteum if possible.^[33]

Initial treatment should always be conservative. The lesion should be carefully cleaned, and any small sequestered bony fragments are carefully removed. Oral hygiene procedures are reviewed, and the patient is asked to rinse frequently with dilute hydrogen peroxide or a salt and soda solution in an effort to keep the area moist and clean.^[34] Dentures are relieved over the affected area, and soft plastic mouth guards have also been used as protective devices. Topical packing of the area with zinc oxide and various antibiotics has been recommended.^[29,34]

Partial mandibulectomy may be necessary in severe cases of ORN, mandible can be reconstructed for esthetics and function.

DENTAL CARIES

After standard radiotherapy, there is preformed shift in the oral microflora with a decrease in salivary flow, it can cause dental caries.

PREVENTION AND TREATMENT

A strict daily oral hygiene regimen that includes fluoride and meticulous plaque removal has been shown to prevent the development of caries.^[18,19] Topical fluorides or chlorhexidine rinses may lead to reduced level of *S. mutans* but not of *Lactobacilli*. Due to the possibility of adverse drug interactions, fluoride and chlorhexidine dosing should be separated by several hours.

Vissink *et al.*^[35] concluded that a lifelong commitment to improved oral hygiene and home care should include meticulous oral hygiene and frequent self-application of fluoride either neutral sodium fluoride, 1% gel applied at least every other day. The daily use of 4% stannous fluoride also can be effective.^[19,36,37]

POSTRADIATION PROSTHODONTIC CARE

Patients treated with radiotherapy suffer substantial changes to the oral mucosa and often require new complete or partial dentures. Ideally, the oral soft tissue must be adequately healed before necessary prosthodontic procedures can be initiated. There are suggestions that a latent period of at least 6 months to 1 year should be provided.^[34]

TOOTH DECAY

Radiation-induced dry mouth is a common and significant consequences of head and neck radiotherapy, oral dryness reflects the progressive radiation-induced salivary gland acinar cell inflammation, fibrosis, and degeneration.^[5] The salivary glands are very sensitive to radiation. There is a sharp decrease in the salivary flow rate during the 1st week of RT with conventional fractionation (2 Gy/day). The decrease in flow rate is continuous throughout the treatment period especially when both parotids are irradiated. This correlates to the dose and duration of RT. There is immediate serous cell death accomplished by inflammatory cell infiltration and then continuous reduction of salivary flow rates. Patients often complain of thick, ropy, saliva, and a sensation that there is too much saliva because it is difficult to swallow.^[26]

Kaplan quotes a study by Drizen showing a reduction of salivary pH from a mean of 7.01 to 6.83 after 6 weeks radiation (50 Gy cumulative dose 10 Gy/week) to the major salivary glands. Significant increase in the concentration of salivary sodium chloride calcium magnesium and protein accompanied the decrease in salivary output, and a reduction of bicarbonate content is also seen. These changes make xerostomic saliva a much more saline rich and poorly buffered secretion than normal saliva.^[38]

Valdez found that salivary flow rates were significantly increased in those patients who received <50 Gy compared to those patients who received >68 Gy. Furthermore, glands that were only partially irradiated had hyper-flow rates that than the fully irradiated glands.^[39] In the same study, it was found that the probability of the presence of residual function was higher in glands which were not totally irradiated. Therefore, if irradiation of salivary tissue can be spared by patient positioning or shielding, resultant salivary gland dysfunction can be reduced.^[40]

DENTAL EXTRACTION

A conservative approach is advised in regard to extraction of teeth after radiation.^[41] Extraction should only be

considered after careful evaluation. Extremely mobile periodontally compromised teeth can be safely removed with minimal risk of developing ORN.

EDEMA

Early in the postradiation period, scarring fibrosis and edema begin to appear lymphatic channels are thought to be relatively radio-resistant. Radiation-induced fibrosis impairs the lymphatic and venous channels. Edema is most prominent in the submental region following irradiation for anterior tongue and floor of the mouth and occasionally severe enough compromise tongue mobility and salivary control further impending denture wearing and speech articulation. The severity of edema varies by time of the day (worse on waking and early morning and day to day).

CONCLUSION

To minimize patient discomfort and morbidity, an understanding of the deleterious effects of radiotherapy is required. Introducing good oral home care and more frequent oral prophylaxis visits to the dentists before radiotherapy will allow for continuing care during and after therapy.

The cancer patient who is to receive or has received curative doses of radiation to the head and neck cancer presents a challenge for the dentist.

The importance of patient compliance should be emphasized.

Goals of dental management should be

- Pretreatment goals
 - Eliminate potential source of infection
 - Counsel patient about short- and long-term complications of radiotherapy
 - Provide preventive care.
- Goals during radiotherapy
 - Provide supportive care for oral mucositis
 - Provide treatment of oral candidiasis
 - Manage xerostomia
 - Prevent trismus and fibrosis.
- Long-term posttreatment goals
 - Manage xerostomia
 - Prevent and minimize trismus
 - Prevent and treat dental caries
 - Prevent post radiation osteonecrosis
 - Detect tumor recurrence.

Eat a well-balanced diet

- Wear removable dentures or device as little as possible
- Don't smoke

- Don't drink alcohol
- Use topical antibiotics
- Use pain killers as required
- Surgery to remove dead bone or rebuild bone of mouth and jaw.

With conventional RT, xerostomia is permanent. Salivary gland-sparing techniques using IMRT have been now in use. IMRT is rapidly emerging as the standard of care for head and neck cancer. Salivary gland-sparing IMRT is associated with a gradual recovery of salivary flow over time and improved quality-of-life as compared to conventional RT. A team including speech therapist, dietitian, dental specialist, and psychologist along with radiation oncology is required to deal with those complications and prevent morbidity and mortality of head and neck cancer patients during and after radiotherapy.

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